3 The Cold War and the Early Atomic Energy Commission (1945–1950)

The conclusion of World War II in August 1945 produced tremendous euphoria, in which it was widely hoped that the world would finally achieve the stable peace that had not been won by the First World War. The United Nations, established in San Francisco and later moved to New York, was a concrete expression of that wish. Still, it could not be forgotten that final victory had been achieved by two atomic bombs, and that only one nation had them. Interest in the new weapons was only heightened by the release of the official report of the *Manhattan Project, Atomic Energy for Military Purposes*.[1] The ultimate fate of atomic energy was a major controversy—both in this country and around the world—in the first year after the war, from the summer of 1945 to the summer of 1946.

Prime Minister Winston Churchill, President Harry S. Truman, and Marshal Josef Stalin face a battery of photographers prior to the start of the Big Three Meeting in the Potsdam area of Germany. James F. Byrnes Papers, Mss 90, negative 209237-S. Courtesy of the Special Collections, Clemson University Libraries, Clemson, South Carolina.

THE QUESTION OF INTERNATIONAL CONTROL

In 1945, the nuclear inner circle consisted of Britain, Canada, and the United States, and only the latter could actually make a bomb. Many nuclear physicists, guilt-ridden over having created such a powerful weapon, advocated international control over atomic energy to guarantee mutual security and to prevent an international arms race. Niels Bohr, Enrico Fermi, Robert Oppenheimer, David Lilienthal, and Dean Acheson were among the physicists and politicians who spearheaded this drive. Their view was roughly summed up in Bernard Brodie's 1946 book, *The Absolute Weapon: Atomic Power and World Order*, which argued that peace would be more assured if every power had the bomb, or an essential part of the bomb, rather than one nation with a monopoly.[2]

Most politicians, no less awed by the bomb but less guilt-ridden, were not swayed by the internationalist argument. Most were incredulous when it was suggested that a weapon—built with billions of dollars of taxpayers' money—should simply be given away to satisfy the hope of international control. One of the first to stake out a position in this camp

was Jimmy Byrnes, Truman's Secretary of State and powerful right-hand man, and he kept company with Leslie Groves and Winston Churchill.[3]

President Truman started out as a fence-sitter. He dabbled with the idea of international control in the first months after the war, before he came to favor a more nationalist position. As a result of this dabbling, however, Truman approved a committee to examine the postwar development of nuclear energy, which would include the possibility of some sort of international control. The committee, chaired by Dean Acheson, included, among others, Byrnes, Groves, Bush, and Conant. To aid the committee with technical information, Acheson appointed a five-man team that included Charles Thomas, Henry Winne, Chester Barnard, Robert Oppenheimer, and David Lilienthal, head of the Tennessee Valley Authority. This group laid the foundation for what came to be called the Acheson-Lilienthal Report.[4]

President Harry S. Truman, Secretary of State James F. Byrnes, and Admiral of the Fleet William D. Leahy, on tour of Berlin, stop to view the ruins of the Reichstag building. Hitler had addressed his followers from the balcony of the chancellery in the background. James F. Byrnes Papers, Mss 90, negative 209344. Courtesy of the Special Collections, Clemson University Libraries, Clemson, South Carolina.

Released in February and March 1946, the Acheson-Lilienthal Report championed the idea of international control of atomic energy. It proposed that the nuclear facilities needed to make atom bombs be spread around the world to ensure that no one nation could have a monopoly. The report also stressed the importance of open facilities and verification by all parties. The Acheson-Lilienthal Report found a lot of favor when it was released, and it became the basis of the Baruch Plan that Truman presented to the United Nations later that summer.[5]

The plan prepared by Bernard Baruch took its theme from the Acheson-Lilienthal Report, but it was more realistic about the problems of internationalizing atomic energy. It recognized that any international scheme would have problems with security, and stated baldly that world peace would be impossible without the force to back it up. The Baruch Plan was submitted to the United Nations for consideration in June 1946, but it was doomed from the start. The Soviet Union had no intention of opening its facilities to third-party verification, and over the next few months the Baruch Plan prompted counter-proposals that the United States found unacceptable. Before the end of the year, the plan was dead, and with it any realistic dream of international control.[6] The bomb would remain an American monopoly, for the time being at least, and the stage was set for an arms race that was not quite ready to begin.

LAST DAYS OF THE MANHATTAN PROJECT

In July 1946, while the Baruch Plan was being debated at the U.N., the Manhattan Engineer District (MED), in conjunction with U.S. military authorities, conducted the first

nuclear tests since the summer 1945. Scheduled as three tests, Operation Crossroads was conducted at Bikini Atoll in the Marshall Islands. The first shot, "Able," was an above-water test that yielded relatively minimal amounts of radiation. This was not the case with "Baker," an underwater explosion that generated more radioactivity than was expected. The third test, scheduled for deep water, was cancelled by Truman himself.[7]

Crossroads was one of the last stirrings of the Manhattan Project. Left without a clear mission since the end of World War II, the Manhattan Project had been depleted by the exodus of physicists in the months that followed the war. Oppenheimer himself left to become director of the Institute for Advanced Study at Princeton.[8] A MED committee did weigh in on the international-control controversy by urging the United States to maintain nuclear superiority,[9] but for the most part the Manhattan Project held its own, repairing the damage left by vacancies as best it could.[10]

Bernard Baruch, a native South Carolinian, was the author of the Baruch Plan that Truman presented to the United Nations in 1946 on international control of atomic energy. Here he (far left) is shown with Governor James Byrnes and Strom Thurmond (right) at the James Byrnes Testimonial dinner held at the Willcox Hotel, Aiken, South Carolina, April 16, 1955. All three South Carolinians would play a role in the shaping of atomic energy and its development, both in the state and in the nation. They were accompanied by (left to right) Mrs. Sarah Bush, Miss Elizabeth Nevans, Mrs. James F. Byrnes, and Mrs. Strom Thurmond. Strom Thurmond Collection, Mss 100, negative 1195. Courtesy of the Special Collections, Clemson University Libraries, Clemson, South Carolina.

Companies also left, requiring the introduction of new firms to the nuclear fold. Monsanto Chemical replaced the University of Chicago as the prime contractor at Clinton Laboratory in the summer 1946.[11] Just as dramatic was the departure of Du Pont. Holding MED to its promise that the company could be relieved after the war, Du Pont relinquished operation of the Hanford Engineer Works on September 1, 1946. Groves enticed General Electric to take their place, which GE did with a one-dollar-profit contract similar to Du Pont's. In return, GE received a government commitment to help build a GE laboratory then under consideration just outside Schenectady, New York.[12]

Hanford had other problems. The wartime reactors were aging: Reactor B was shut down as a precaution, and D and F were forced to operate at lower power.[13] In 1946, MED planned to construct two additional plutonium reactors, in addition to two small test reactors at Los Alamos.[14] Even though the MED put these plans into play, it would not see them completed. By the Bikini Tests, legislation was already under way to place the nation's nuclear program under a civilian-controlled entity known as the Atomic Energy Commission.

CREATION OF THE ATOMIC ENERGY COMMISSION, 1946–1947

The U.S. Atomic Energy Commission, the direct successor of the Manhattan Engineer District, was the result of another controversy around the use of atomic energy. Closely tied with the dilemma of international control was another question: Should the U.S. atomic program remain under military jurisdiction, or be turned over to civilian control? Military control certainly had its supporters. A bill giving atomic power to the Army almost passed the House Military Affairs Committee in October 1945, and there were other attempts as well.[15] By 1946, however, the political tide seemed to favor civilian control, and almost all who had favored an international arrangement favored this option, including Truman.[16]

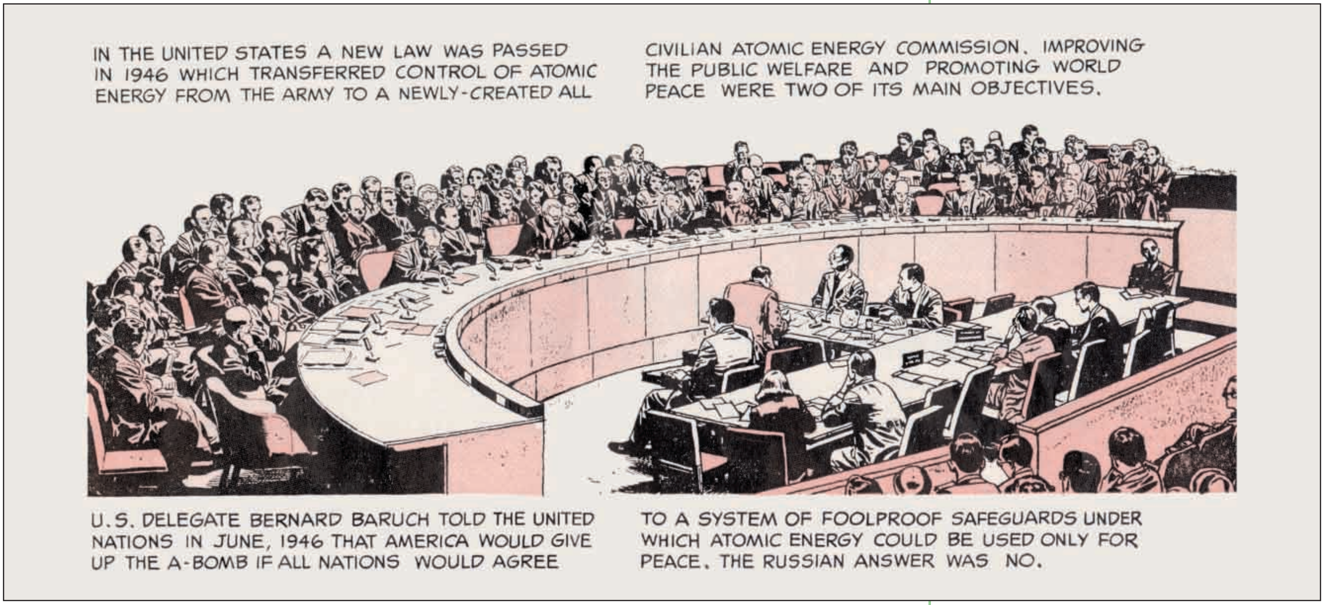
The push for civilian control came to a head in the summer 1946. At that time, the McMahon Act, also known as the Atomic Energy Act, sponsored by Senator Brien McMahon of Connecticut, passed Congress in July and was signed into law by Truman on August 1.[17] The Atomic Energy Act established a civilian-led U.S. government nuclear

monopoly known as the Atomic Energy Commission, answerable to Congress and the President. Nuclear information would be restricted, and no private companies or individuals could own nuclear materials or patent nuclear inventions. Without specifically stating it, the charter of the Commission gave it total control over atomic energy. The Atomic Energy Commission, or AEC as it was often called, was to take over all Manhattan Engineer District initiatives, properties, and programs on January 1, 1947.[18]

The Atomic Energy Commission consisted of five members, with one member designated chairman. All members were to be appointed by the President and approved by the Senate. Commission terms were to be five years, but the first five commissioners would have a fixed term of two years, plus an additional term of one, two, three, four, or five years, so that each subsequent commissioner would have his five-year tenure staggered by a year. This was to prevent an unwarranted accumulation of power within the commission, and allow smooth transitions within the AEC.[19] The Commission itself, however, was granted considerable leeway in the operation of its atomic program. It was given the authority to run the atomic program with government employees if it so chose, reversing the MED method of using private companies supervised by the government. The Commission was also exempt from Civil Service laws, allowing it complete freedom in dealing with its employees.[20]

The law also created a number of entities to serve the Commission. A General Manager would handle administrative and executive functions; like the commissioners, he would be appointed by the President and approved by the Senate. The law also established two essential committees to aid the Commissioners. The first, and most important in what was still a relatively new field, was the General Advisory Committee (GAC), designed to advise the Commission on all scientific matters. The committee was composed of nine members with six-year terms. GAC members would be appointed from civilian life by the President. The GAC was required to meet at least four times a year and to designate one of its members to serve as chairman, elected annually. The second committee was the Military Liaison Committee, which would coordinate the Commission's

Brien McMahon, Chairman of the Joint Committee on Atomic Energy. Courtesy of SRS Archives, negative M-364.



Cartoon taken from M. Phillip Copp, Booklet entitled *The Atomic Revolution*, 1957. Courtesy of SRS History Project.

David Lilienthal, first chairman of the Atomic Energy Commission. Courtesy of the Tennessee Valley Authority.

work with the military's requirements. Below these two committees, the Commission would have various divisions to handle the production of nuclear materials and their assembly, and any other work the Commission deemed necessary. The law also established the Joint Committee on Atomic Energy, composed of nine Senators and nine Representatives, to oversee the AEC and its activities.[21] Brien McMahon, sponsor of the Atomic Energy Act of 1946, served as the first Joint Committee chairman.[22]

The commissioners appointed by Truman were David Lilienthal, Sumner Pike, Lewis Strauss, William Waymack, and Robert Bacher. The chairman of the AEC was a powerful figure, and few occupants of that position put more of a stamp on the organization than did the first, David Lilienthal. Appointed by Truman in October/November 1946, Lilienthal was a veteran of Roosevelt's New Deal administration, having served as co-director and later first chairman of the Tennessee Valley Authority in the 1930s and early 1940s.[23] As Lilienthal himself admitted, he knew little about atomic energy when he was pegged for the job. A strong proponent of civilian control, Lilienthal used his new position to stump for a greater appreciation of the peaceful uses of atomic energy, especially the potential for power generation and the creation of isotopes for scientific and medical research.[24] As if to underline this potential importance, the Clinton Laboratory (later the Oak Ridge National Laboratory) began dispensing radioisotopes to interested agencies around the world as early as August 1946, months before the AEC took over the American nuclear program.[25]

Robert Oppenheimer was appointed to the General Advisory Committee in 1946, and was elected chairman of the GAC at its very first meeting in early January 1947. He too proved to be a powerful figure, and was re-elected chairman every year of his six-year term. Under Oppenheimer, the GAC chose not to conduct its business through a staff, but rather to keep its deliberations closed and work close to the vest. This work was highly classified. It soon developed that the chairman of the GAC would prepare a report that would go directly to the AEC chairman at the conclusion of each meeting. In addition, the GAC meeting minutes were provided to the Commissioners for further study.[26]

The MED holdings that the Atomic Energy Commission inherited in early 1947 were larger than those of the wartime Manhattan Project, but the terrain was still recognizable. In addition to the three government-run communities—Clinton (soon renamed Oak Ridge), Hanford, and Los Alamos—the AEC inherited MED plans for new reactors at Hanford, as well as the new national laboratories at the University of Chicago's Argonne site in Illinois, and at Oak Ridge.[27] The AEC also inherited General Groves' commitments for the Brookhaven National Laboratory on Long Island, as well as plans for new research facilities at Schenectady to be run by General Electric.[28] All of this, however, proved difficult to administer during the AEC's first year. The nuclear program was plagued with problems left over from the Manhattan Project, and the Commission itself had to sort out kinks in its organization.

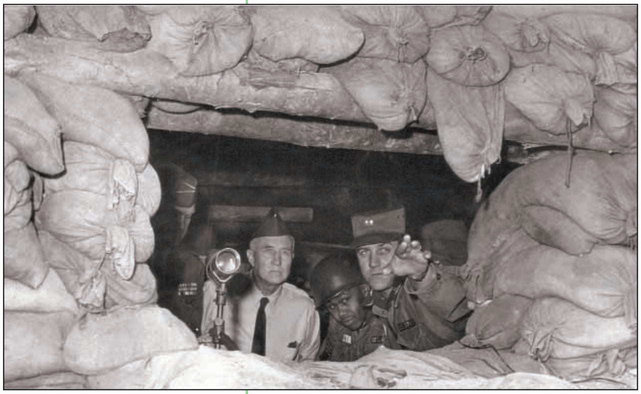
The AEC inherited some of its biggest problems from a MED that was itself in transition after the war. These problems ranged the spectrum of the atomic program, from a chaotic situation at the laboratories, to dilapidated facilities at the three government towns and problems with the new prime contractors. As General Electric officials would admit in later years, their operation of Hanford in 1947 was not up to the standards of Du Pont. GE initially failed to recognize the scope of what had to be done at Hanford and did not put the requisite resources into the job.[29] At Clinton, there was friction between Monsanto

officials and the laboratory authorities left over from University of Chicago days.[30] Morale was low even at Los Alamos.[31] The situation was no better in the three atomic cities. Increasingly incongruous two years after the war, the residential facilities, substandard when they were built, were now completely run-down.[32] The worst of all was the state of the nation's nuclear arsenal. Lilienthal toured the AEC facilities in early 1947 and reported to a shocked Truman in April that the United States had no operable atomic bombs, just bomb parts.[33] Even after the scramble that resulted, there were only 13 bombs by the end of the year.[34]

The Atomic Energy Commission also had administrative problems. Unlike the MED, which was allowed remarkable autonomy, the AEC had to contend with a greater slate of issues, as well as Congressional oversight. Lilienthal was not confirmed by the Senate until mid-1947. In addition, the early commissioners were political appointees who lacked technical proficiency in the whole range of topics that would quickly come under the domain of the Commission. To address this deficiency, the AEC commissioners established new advisory committees responsible for certain key areas not foreseen when the Commission was created.[35]

The Atomic Energy Act authorized AEC divisions in Research, Production, Engineering, and Military Applications, each with its own director.[36] After the AEC began operation, it created additional advisory committees to handle Raw Materials, Biology and Medicine, Administrative Operations, and Reactor Development.[37]

The Atomic Energy Commission was still working out its organizational flaws when the Cold War, heralded since the beginning of 1946, took a serious turn in 1948 with the Berlin Blockade. From that year on, the Cold War became a steamroller that flattened many peripheral issues, including any doubt that the Commission might have had that its primary function was to produce nuclear materials for the military. A casualty of this development was the loss of a New Deal sense of openness and any immediate hope for significant peaceful uses of the atom.[38]



Along the Iron Curtain. Looking into communist East Germany from 11th Armored Cavalry Regiment observation post. Senator and Brigadier General in the U.S. Army Reserve Strom Thurmond, Representative Leroy Anderson, and Captain Harry Peters, 1957. Strom Thurmond Collection, Mss 100, Box 6, Folder 36, Photograph 1034. Courtesy of the Special Collections, Clemson University Libraries, Clemson, South Carolina.

RISE OF THE COLD WAR, 1945–1948

The Cold War and the Nuclear Age developed side by side, but both had their beginnings long before Hiroshima. In this country, the Cold War was under way years before the end of the Second World War, even if that fact was not well recognized in the United States. Soviet operatives, who practiced industrial spying on a massive scale in the 1930s, found their way into the Manhattan Project during the war. Largely as a result of espionage, the Soviets knew how to make a plutonium bomb before the first devices were dropped on Japan. What they lacked was the industrial capacity to make the materials required, and that would take years to achieve.

On the diplomatic front, the first signs of discord between West and East were underlined at Yalta in February, 1945 in discussions of the postwar fate of Poland. As it became increasingly clear in the months to follow that Eastern Europe would remain under the domination of the Soviet Union, public opinion in the West began to shift. The Cold War formally began in early 1946, with war "declared" by both sides. Stalin's speech to the

Communist Party Congress on February 9th announced a resumption of the global anti-capitalist crusade and reaffirmed the Party's dominance in Soviet society. This marked the end of the relatively relaxed era of the Patriotic War. On the Western side, George Kennan's famous February 22nd telegram detailed the resumption of Soviet paranoia, and urged that Communism be contained. On March 5th, Churchill went further in his Iron Curtain speech at Fulton, Missouri, in which he envisioned an atomic arms race.

In 1946 and 1947, problems soon cropped up in Iran, where the Soviets were slow to leave their sphere of influence, and in Greece and Turkey, which were pressured to grant various concessions. The British dealt with most of these problems, since they had a traditional presence in the areas. Eastern Europe, however, on the critical western border with the Soviet Union, was swallowed whole.

Cartoon inscribed "Handle with Care" illustrates the conflict over possession of the atom bomb between the United States and the Soviet Union, circa 1945. Courtesy of the Collections of the Library of Congress.

Western leaders like Truman and Churchill knew that the Soviets were working on the atom bomb, but did not know how far the program had advanced. In 1942, Stalin had approved a research program to work on separating uranium-235 from natural uranium. In 1943, the main Soviet physicist, Igor Kurchatov, was shown the results of Soviet espionage in Britain and the United States, and work shifted toward plutonium. As a result of the espionage of physicists like Klaus Fuchs and Theodore Hall, the Soviets had the plans for the plutonium bomb, including the implosion device needed for detonation.[39]

The bomb effort became more intense when Lavrenti Beria, head of the secret police, was put in charge in 1945. The Soviets soon had their own version of Los Alamos at Sarov, 400 kilometers east of Moscow. It was there that the first Soviet reactor went critical, on Christmas Day 1946.

At this point, with Europe still in ruins, Communist parties throughout western and central Europe were gaining strength. Both to improve the European economy and forestall any further Communist advances, the United States put forth the European Recovery Program, known as the Marshall Plan, in the summer of 1947. The Plan was debated in Congress and throughout Europe in the second half of 1947 and early 1948, and was finally passed by Congress in April 1948. Although aid was proffered to all European nations, Stalin turned down the offer—as was expected—and ensured that the eastern European nations under his thumb did the same. When Czechoslovakia expressed interest in the Plan, the pro-Soviet but democratic government there was deposed by a Communist coup on February 25, 1948. When the Czech state folded into the Soviet camp, the Russians gained direct access to the Joachimsthal uranium mines.[40]

By this time, relations between the former allies had completely broken down. Unable to resolve the fate of a united Germany, both sides made plans to make nations out of the two halves. The German question came to a head with the Berlin Blockade, which began on June 24, 1948, and lasted almost a year, until May 1949. Stalin's prolonged attempt to force the Western Allies out of Berlin was the first direct confrontation between the United States and the Soviet Union, and it laid bare the full implications of a cold war that was just beginning. Before the end of 1949, the Soviet and American camps would be organized along a divide that would split Europe down the middle. The North Atlantic Treaty Organization (NATO), the logical next step after the Marshall Plan, stretched from Norway to Italy. NATO was opposed by the nations of the Soviet block, later known as the Warsaw Pact.[41] In Europe, at least, the lines of the new conflict were clearly drawn.

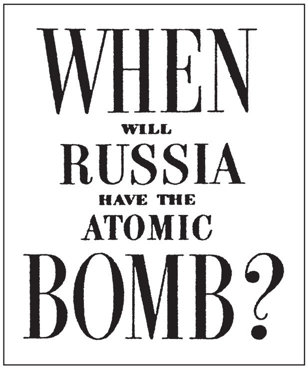
REORGANIZATION AND EXPANSION OF THE AEC, 1948

It took the Atomic Energy Commission well over a year to iron the kinks out of the atomic program inherited from the Manhattan Project, but some of the problems were of the AEC's own making. The AEC was a civilian organization, without a formal chain of command, and this problematic situation was compounded by the decentralized governing philosophy of the chairman, David Lilienthal. It was a philosophy seconded by the first General Manager, Carroll Wilson, who had served as an assistant to Vannevar Bush during the war.[42]

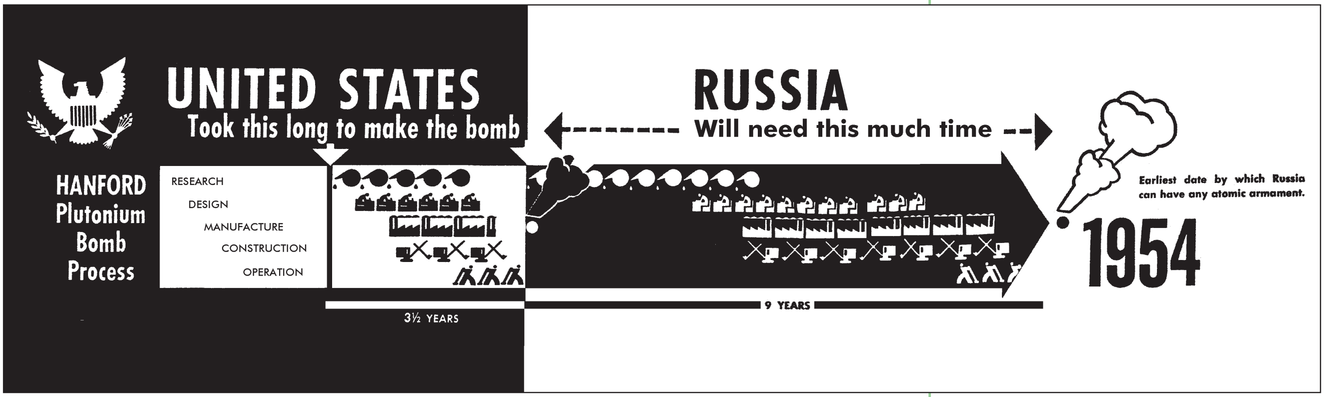
In what came to be called the "Lilienthal-Wilson Approach," the AEC was operated in this fashion during its first year and a half.[43] Lilienthal had used this approach in the operation of the Tennessee Valley Authority, and he thought it would work with the AEC as well. From the beginning, Lilienthal believed that the MED had been too centralized, with authority concentrated in Groves' office at Oak Ridge.[44] Lilienthal went the other way, with field-office managers at Los Alamos, Oak Ridge, New York, Chicago, and Hanford, all allowed considerable leeway in executing their duties. Each field-office manager reported to Carroll Wilson individually.[45]

One of the first agencies to see the flaw of this arrangement was the Industrial Advisory Group (IAC), established by the Commission near the end of 1947. Although its primary mission was to explore ways to increase the participation of private industry in the atomic business, it was also commissioned to review the AEC's organizational strengths and weaknesses.[46] The IAC discovered that the organizational links were too weak. Field managers not only had too much authority, but the arrangement was also too "geographical," with managers in control of little fiefdoms. Since they all reported directly to Wilson, the General Manager was overburdened. In addition, the group found that there was not enough attention devoted to the problems of production, and research and design.[47] To correct the organizational problem, at least, the group recommended a layer of administrators between the General Manager and the field offices.[48]

The AEC organizational problems came under increasing attack in spring and summer of 1948. It was then that the two-year trial period of the commissioners was scheduled to end, with each beginning staggered terms: Lilienthal, five years; Pike, four; Strauss, three, Waynack, two; and Bacher, one. This meant another round of confirmation hearings, which promised to be difficult. Even though the commissioners' terms were extended another two years in a compromise sponsored by Senator Hickenlooper, it was not before



(Above and Below) In the first years after World War II, it was assumed that it would take the Russians several years to develop the atom bomb. The unsourced newsclipping below projects a possible timeline developed in 1948, forecasting that Russia would need nine years to accomplish what took the United States 3 and a half years. Newsclipping, source unknown, dated March 16, 1948, courtesy of SRS Archives.



the AEC was raked over the coals for persistent fiscal problems and the dangerous autonomy allowed its field managers.[49]

Even the General Advisory Committee weighed in on this issue. In June 1948, the GAC, led by Robert Oppenheimer, launched a direct attack on Lilienthal and the commissioners. According to Oppenheimer, the Commission was too decentralized to provide the direction needed to keep the atomic program focused on urgent issues. As a result, the Commission was not able to make good use of the GAC's advice. Worse, the scientific community was starting to lose faith in the atomic program.[50]

In August and September 1948, Lilienthal and the other commissioners bowed to the inevitable and effected a general reorganization. The Commission's functions were centralized into four executive divisions: Research, Production, Reactor Development, and Military Application. Each of these divisions was equipped with its own program, budget, and planning department. Raw Materials, previously independent, was placed under Production; other areas of the AEC were similarly streamlined.[51] The office of the General Manager was strengthened, with more staff to handle the greater workload. From the evidence provided by the AEC General Manager's files, Carroll Wilson got the staff he needed to coordinate the various field managers.[52]

After the reorganization, the core of the new AEC was the Division of Production. Its main functions began with the procuring of raw materials, and continued through the processing of raw materials, the production of feed materials for the reactors, and the production of fissionable materials as a result of reactor operation. The Division of Production was also responsible for providing other materials needed for AEC operation. Its other functions included supervising the engineering and construction activities of the AEC, managing the AEC communities (Oak Ridge, Hanford, and Los Alamos), and providing management support for the other divisions. It even kept maintenance records on source and fissionable materials, prepared AEC mobilization plans, and administered all production facility licensing, source material licensing, and equipment export control.[53] The Director of Production was Walter Williams, who had served as Groves' production chief during the Manhattan Project, and was director of field operations before the reorganization.[54]

The reorganization allowed the AEC to operate more effectively, even as its facilities continued to grow. By the end of 1948, the AEC had increased its physical facilities in two directions: by adding to the older facilities inherited from the MED, and by building new ones. The AEC's empire included a headquarters in Washington, DC; the old Manhattan Project properties at Oak Ridge, Hanford, and Los Alamos; and a wide range of facilities that had been developed or enlarged since the war. These included the Argonne National Laboratory, which came out of the Metallurgical Laboratory; the Oak Ridge National Laboratory, which developed out of the Clinton Engineer Works Laboratory; and the new Brookhaven National Laboratory on Long Island. Under construction was the Knolls Atomic Power Laboratory in Schenectady, New York. Each main facility had ties to other institutions in the same geographic area.[55] These different nodes of the AEC were controlled through operations offices, generally centered around one of the major facilities. In addition to headquarters in Washington, DC, there were operations offices at Oak Ridge, Santa Fe, Hanford, Chicago, and New York.[56]

To operate these facilities, the AEC received tremendous sums of money through Congressional appropriations, and the appropriations increased every year. The budget for

fiscal year July 1948–June 1949 was $625 million.[57] From that sum, the AEC only spent $26 million on itself, which was used to pay five Commissioners, the General Manager, 21 administrative executives, and the 5000-strong staff in Washington and around the country. The rest, some 96 percent, went to the various private companies that operated the facilities under AEC supervision.[58]

Out of the 1949 budget, GE received a total of $208 million to run Hanford for the production of plutonium, as well as for the nuclear research facilities at Knolls, then under construction. The other prime contractors received considerably less money. Carbide and Carbon Chemicals got $60 million as the prime contractor at Oak Ridge, where gaseous diffusion was used to separate uranium-235. The University of California received $37 million to operate Los Alamos and the Radiation Laboratory. The University of Chicago received $35 million to run Argonne, the center for reactor research. Associated Universities, Inc., a consortium of Ivy League schools for the purpose of nuclear research, got slightly less for the operation of Brookhaven. Other large firms involved or associated with AEC operations included Allied Chemical and Dye, Dow Chemical, American Cyanamid, Kellex Corp., Westinghouse Electric, Monsanto Chemical, Tennessee Eastman, and Du Pont.[59]

The last two firms, Tennessee Eastman and Du Pont, had already retired from direct involvement with the government's atomic service. Tennessee Eastman left Y-12 at Oak Ridge in May, 1947, to the relief of both the government and Tennessee Eastman. Du Pont's case, however, was different. The former munitions—now plastics—firm had done an exceptional job at Hanford, and it was only at Du Pont's insistence that the company was let out of its contract in late 1946, before the AEC took over the atomic helm.[60]

In 1948, the main star in the AEC firmament was General Electric, the producer of plutonium. When Du Pont left Hanford, General Electric was enticed to enter the program with the promise of money for the new Knolls research facility that GE had already planned near its main headquarters in Schenectady, New York.[61] As a result of construction work, both at Knolls and at Hanford, much of the money GE received from the Commission was passed directly to the company's subcontractors.[62]

Hanford represented a big investment for General Electric. By the end of 1948, the plutonium plant accounted for 10 percent of GE's technical staff and 5 percent of its labor force, a very sizable investment for General Electric. This had not been the case during GE's first year at Hanford, where, by all accounts, the company underestimated the scope of the task, and operated without an adequate staff. In April 1948, former GE vice-president Roy C. Muir had been called out of retirement to correct the situation, and he had borrowed Du Pont employees to help him do it.[63]

None of these problems precluded new construction at Hanford, which was much larger than it had been in the summer of 1945.[64] Foremost among the new construction programs were two new graphite-moderated reactors, H and DR. Designed as replacements for the wartime reactors (B, D, and F), the new reactors were under construction by the end of 1948. H Reactor would go online in October 1949; DR Reactor would follow a year later.[65]

Construction was not as dramatic at the other former MED installations, but there were changes there as well. At the end of 1948, the prime contractor at Oak Ridge was Carbide and Carbon Chemicals, a subsidiary of Union Carbide. Carbide and Carbon had run K-25, the gaseous diffusion plant, since the early days of the Manhattan Project. By

1948, it also operated the other facilities, Y-12 and X-10. (Monsanto Chemical, which had operated X-10 and the Clinton Laboratory since mid-1946, retired from the job in March 1948). By the end of 1948, only K-25 was still used to separate uranium-235 from natural uranium. Since the war, improvements in the gaseous diffusion process made K-25 much more effective than Y-12, which was now relegated to making stable isotopes in concert with the X-10 pile, which solely produced experimental radioisotopes.[66]

One of the greatest problems for the AEC at the older facilities was the management of the government towns inherited at Hanford, Oak Ridge, and Los Alamos. Perhaps essential for the Manhattan Project, they were definite anachronisms in the postwar era. Each community had an AEC manager, and their reports to Wilson were filled with details of rent problems and other mundane issues that the General Manager would clearly have preferred not to address. By the end of 1948, it seems clear that the AEC was already looking for ways to divest itself of the government towns, and it certainly had no intention of creating new ones.[67]

In the new facilities planned and built by the AEC, government towns were not really an option, since none was a production center that would require a sizable workforce. For the most part, the new facilities were research laboratories. Brookhaven was already in operation by the end of 1948, and Knolls Atomic Power Laboratory would open in December of 1949. In the planning stage and soon to be approved (February 1949) was The National Reactor Testing Station that would encompass 890 square miles in Idaho. It would be operated by Argonne National Laboratory in Chicago and would test new types of reactors, including reactors for Navy submarines, as well as the materials and processes used in new reactors.[68]

The attention to research had begun to yield results. In 1948, the basic reactor was still what it had been in World War II, with uranium as the fuel and graphite as the moderator, but the range of fuel and moderator options was now much wider. Enriched uranium, uranium with a higher than normal percentage of uranium-235, could be used for reactor fuel and heavy water was now practical as a moderator.[69]

The development of heavy-water technology was one of the great achievements in reactor research after the war. It had long been recognized that heavy water had a better neutron economy than graphite, but logistical problems restricted its use during the Manhattan Project. The Argonne Laboratory concentrated its work on heavy-water-moderated reactors soon after the war, and by 1950 there were two such test reactors at Argonne: CP-3 and CP-5. This complemented the heavy-water-moderated NRX-Reactor in Canada, which had been in operation since July 1947. The tremendous problem posed by the limited supply of heavy water was at least partially resolved by a contract between the AEC and the Girdler Corporation. The contract called for a heavy-water pilot plant and production facility at the Wabash River Ordnance Works in Indiana, soon known simply as the Dana Plant. The process that Girdler used involved the "dual temperature exchange of deuterium between water and hydrogen sulfide gas." The process became known as the "S-process," or "GS" for Girdler sulfide. By the late 1940s, the AEC researchers clearly preferred heavy water for reactor moderation, even though the Commission did not yet have a single heavy-water production reactor.[70]

Other types of reactors were also explored. The atomic age began with production reactors, or reactors that produced the fissionable material essential for an explosive device. There was always, however, the possibility that power reactors could produce

electricity. As a civilian organization, the AEC was interested in peaceful uses of atomic energy, and the idea of a power reactor had great appeal. Physicists at both Argonne and Oak Ridge knew how to build such a reactor, but the catch was to make it profitable. Even though modern commercial power reactors burn uranium-235 and do so profitably, this was not thought possible in the late 1940s. So long as power reactors simply burned up valuable uranium or even more precious plutonium, it was widely believed that they could never be commercially viable.

For this reason, the AEC had long been interested in breeder reactors. As early as the GAC meeting of February 2, 1947, one of the three main priorities established for the AEC was to develop power-breeder reactors and high-flux reactors.[71] The possibilities of breeder reactors and the materials used in them would change over time. In the late 1940s, it was hoped that breeders would make fissionable uranium-233 from fission materials such as natural thorium. In this fashion, a reactor could produce fissionable material while it produced power. This was the only way thought possible to produce profitable electricity, and even this was not an imminent event. In 1948, the GAC stated that power from commercial reactors would not be economically feasible for another 20 years.[72]

As a way to save expensive uranium-235, the breeder reactor was long a favorite research topic for the AEC, with the first experimental breeder constructed as early as 1947.[73] This research would continue for years to come, but breeder reactors never became economically viable. One basic problem was that when reactors operated best for breeding, with fast neutrons, they were not in the best operational mode for power generation.[74] Despite this dilemma, what finally slowed the development of the breeder reactor was the discovery of vast new reserves of uranium throughout the United States, making the need for breeders less obvious.

THE PLUTONIUM PROJECT AND THE RETURN OF DU PONT

Concern for the expense of fissionable material led to improvements in production techniques as well, and these were more immediately successful. Methods were improved to save and recycle plutonium and spent uranium after they left the reactor. The standard process in the war had been to use bismuth phosphate to separate plutonium from the irradiated material. Bismuth phosphate, however, was not sensitive to uranium, and it was hoped that another process might be less wasteful of the spent uranium, much of which ended up in underground storage tanks. Since 1944, the Redox process had been known as a way to recover both plutonium and spent uranium simultaneously. Although it produced better results, it was also more expensive.[75]

These concerns led to the Plutonium Project in 1948–1949, an overall attempt to improve the Redox process and increase uranium recovery from existing waste tanks.[76] As Carroll Wilson put it, the project was an attempt to process plutonium so as to make the best use of uranium, still a rare commodity that usually came from the Belgian Congo. Because of the chemistry involved, and the company's good record at Hanford, the Plutonium Project was awarded to Du Pont.[77]

Although Du Pont was eager to get out of the atomic business at the end of World War II, and left Hanford in September 1946, it could be argued that it never really left the fold. Its Hanford work was too good, and the company knew too much, to be left out of

the inner circle. Throughout 1947, Du Pont's Wilmington office provided records and other assistance to General Electric, its replacement at Hanford.[78] Contracts were effected between GE and Du Pont in February, 1948 concerning the loan of Du Pont personnel for work on new reactor design and construction.[79] Du Pont even loaned personnel to Brookhaven National Laboratory for research on graphite reactors.[80]

Crawford Greenewalt, who had been in charge of Du Pont's work at Hanford, was asked to serve on a number of atomic energy committees. In 1948, his industrial background was required on a panel for the AEC Committee on Atomic Energy Research and Development, chaired by Robert Oppenheimer.[81] In late 1948 and early 1949, after Greenewalt had been made president of Du Pont, he still met with the AEC's Division of Reactor Development. This body reviewed, among other things, Oak Ridge National Laboratory plans for an experimental high-flux reactor.[82] In the Plutonium Project report of March–April, 1950, Du Pont concluded that uranium was indeed used inefficiently, and that new methods of uranium recovery, which had the potential for improvements on Redox, should be explored.[83]

Naval spectators wearing goggles watch explosion of atomic bomb during Operation Sandstone on the Enewetak Atoll, 1948. Courtesy of the Collections of the Library of Congress.

TACTICAL ATOMIC WEAPONS VS. THE HYDROGEN BOMB, 1948–1949

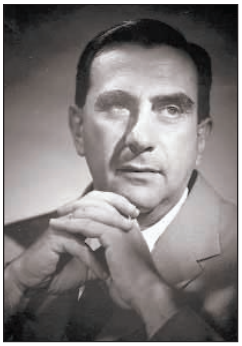
Despite pious disclaimers from Lilienthal and the other Commissioners, the main purpose of the AEC was not to produce isotopes for medical research or to study power reactors for electricity, but to produce fissionable material for the military. This led to fanciful projects like the Nuclear Energy for the Propulsion of Aircraft (NEPA), and to the highly successful submarine propulsion system studied by Westinghouse Electric for the Navy. For the most part, however, this work came down to producing and stockpiling atomic bombs.[84]

As the Cold War heated up in 1948 and early 1949, the AEC and the three branches of the military became embroiled in a controversy over the path to take in developing future generations of nuclear bombs. Tests conducted in the fall of 1948 demonstrated for the first time that small nuclear devices could be employed as tactical weapons on the battlefield. There loomed the possibility of the hydrogen bomb, dubbed the "Super," which had been studied during the Manhattan Project. The development of either option promised to be expensive, and both were fraught with moral dilem-

mas. Tactical A-bombs reduced the scale of destruction and made it more likely that atomic weapons would be used; the Super, alternatively, was much more powerful than anything produced by the Manhattan Project. Hydrogen bombs made it less likely that nuclear weapons would be used, but if they were, the destruction would be vast.

Ever since the days of Hiroshima and Nagasaki, it had been assumed that a fission bomb was simply too powerful to yield effective results on the battlefield. This meant that atomic war was reduced to massive annihilation, a prospect that troubled many of the physicists who had worked on the Manhattan Project. A bomb with a smaller yield, however, might be used in battle if the risks to friendly forces could be sufficiently reduced. Operation Sandstone, conducted on the Enewetak Atoll in April and May of 1948, demonstrated the practicality of mass production of bomb components.[85]

The "pacifist" wing of the AEC, which included Chairman David Lilienthal and GAC Chairman Robert Oppenheimer, championed the results of the Sandstone tests, and all that these results implied. Their enthusiasm, however, should be viewed in the context of the controversy over the Super. Neither Lilienthal nor Oppenheimer wanted to develop the hydrogen bomb, which they considered morally reprehensible. In hopes of heading off that development, they ordered that Los Alamos concentrate its efforts on developing tactical weapons. This decision was supported by both the Army and the Navy, which saw the new development as a means of harnessing atomic energy for their own purposes.[86]



Edward Teller, Hungarian-born physicist and atomic energy pioneer. Performed atomic energy research at Columbia University during WW II. He was pivotal in the successful explosion first U.S. hydrogen bomb. Between 1952 and 1960, Dr. Teller was the director of the University of California's Lawrence Livermore Radiation Laboratory. Courtesy of the Lawrence Livermore National Laboratory.

The Super also had powerful supporters. Edward Teller, who had worked on the idea of the hydrogen bomb since the Manhattan Project, believed it was essential for the nation's defense, and this position was supported by General Curtis LeMay and the Air Force, which had become tremendously influential in the years after the Second World War. With the military cutbacks since the war, the Air Force's Strategic Air Command (SAC) had become the nation's first line of defense, and atomic bombs were the cutting edge of that first line. The hydrogen bomb, in their view, would only sharpen that cutting edge.[87]

EARLY WORK ON THE HYDROGEN BOMB

The Super was based on a hydrogen fusion reaction more powerful than the fission of either uranium or plutonium. The basics of hydrogen fusion were known before the war—even before uranium fission. Ernest Rutherford and others explored hydrogen fusion as early as 1934. While experimenting with deuterium, an isotope of hydrogen, they discovered that two hydrogen nuclei would fuse if they were heated enough to overcome their electrical repulsion. Upon fusion, they released a great amount of energy.

To develop a fusion weapon, it would be necessary to develop a means to generate the high heat needed to ignite fusion fuel. As far back as the Manhattan Project, Fermi and Teller theorized that the fission bomb might be useful as a trigger for a hydrogen bomb. The Super thermonuclear bomb designed in the 1950s in fact involved a fission trigger, which produced tremendous compression, which in turn heated the fusion fuel to ignition.

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By the time of the Manhattan Project, it was also known that fusion would work better with a combination of hydrogen isotopes: deuterium and the rarer tritium. Deuterium and tritium would fuse at lower temperatures than those required for deuterium alone, and tritium fusion could then be used to jump-start other deuterium reactions.[88] In a thermonuclear explosion, the fusion of these atoms would release heat, neutrons, and intense gamma radiation. Edward Teller was detailed to work on the Super, but because the fission bomb was the top priority of the Manhattan Project, he had to be content with theoretical work. Even this was daunting. The calculations required for the fusion bomb were much more demanding than those required for fission. One of the first computers, the ENIAC designed by the Moore School of Engineering at the University of Pennsylvania, was put to work at Los Alamos on the requisite calculations. In April, 1946, Teller and his associates at Los Alamos held a conference to summarize their work on the Super. Not only did they find the Super feasible, but they also recommended the production of tritium to advance further studies. Even though little came of the conference in the aftermath of the war, the physics of the Super, first studied during the Manhattan Project, continued to tease throughout the early years of the Atomic Energy Commission. When the Cold War became a harsh reality in 1948, interest in the Super was rekindled.

The development of the Super, however, would not be easy. A number of different processes had to take place within the bomb itself, almost instantaneously, to ensure a powerful fusion blast, and these defied understanding for a number of years. Almost as serious were the problems surrounding the physical production of tritium. The heaviest of the hydrogen isotopes, tritium had one proton and two neutrons, usually produced by the neutron bombardment of lithium-6. Not only was tritium highly radioactive, but it would require constant production. Unlike plutonium, with a half-life of 24,000 years, tritium had a half-life of only 12 years. Furthermore, the quantity of tritium needed would require additional reactors. Although small amounts of tritium could be manufactured in a plutonium reactor, this arrangement would not be suitable for mass production.[89]

INTERNATIONAL EVENTS 1949–1950

The full impact of the Cold War began with the Berlin Blockade in 1948. Even so, the emphasis of that conflict was in Europe. In 1949 and 1950, the conflict spread to Asia and became truly global. It began with the crumbling of Nationalist China in late 1948 and 1949 and the rise of Mao Tse-tung's Communists, first in North China and Manchuria, then throughout the mainland. By the time the People's Republic of China was proclaimed, on October 1, 1949, the American public was rocked by even worse news. Years before it was expected, the Soviets succeeded in detonating their first fission bomb on August 29, 1949.

The first Soviet A-bomb, known facetiously as "Little Joe," was exploded with virtually no fanfare.[90] A weather reconnaissance plane picked up the first traces of the blast's radiation, which was confirmed by other sources as the radiation spread eastward over the Pacific.[91] A shocked Lilienthal learned about the blast in mid-September, and Truman announced the Soviet achievement to an equally shocked American public on September 23.[92] To the dis-

Employee identification badge photograph of Klaus Fuchs, a German-born physicist and member of the British Mission to the Manhattan Project, confessed to being a Soviet spy in January, 1950. Courtesy of the Los Alamos National Laboratory.

may of the American physics community, it appeared that "Little Joe" was almost identical to the plutonium device first tested at Trinity.

Within a few months, the connection between Trinity and "Little Joe" would become clear. In January, 1950, British authorities arrested Klaus Fuchs, a German-born physicist and member of the British Mission to the Manhattan Project. Confronted with evidence of his espionage, Fuchs confessed to being a Soviet spy. In the weeks and months that followed, the web of intrigue that had penetrated the heart of the Manhattan Project's plutonium program at Los Alamos raised shock waves on both sides of the Atlantic. And matters only got worse. By the time Communist North Korea invaded South Korea in June, 1950, the Cold War was a full-blown national emergency worthy of almost unlimited financial resources. By this time, there was both the money and the will to develop the Super.

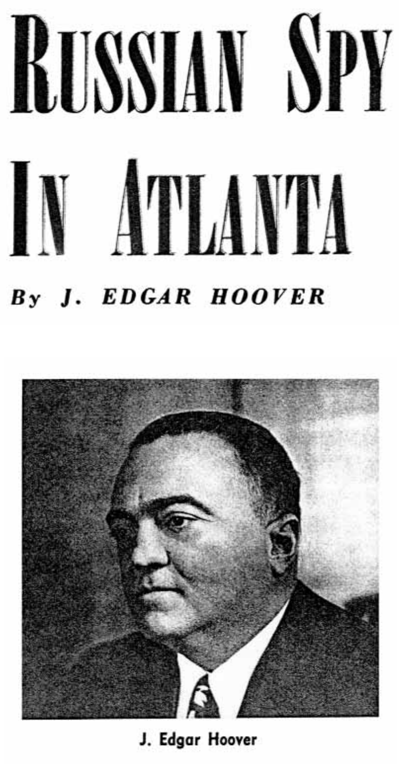
THE DECISION TO DEVELOP THE HYDROGEN BOMB

The Soviet A-bomb paved the way for the American hydrogen bomb. In October 1949, shortly after the announcement of the Soviet blast, the AEC approved an increase in the production of uranium and plutonium, while Edward Teller and the Air Force renewed the call for the development of the Super.[93] Development of the hydrogen bomb was not favored by either Lilienthal or Oppenheimer, both of whom did what they could to halt or slow the landslide. Oppenheimer's General Advisory Committee met to address this issue on October 29–30, 1949. The majority report favored additional research on tritium, but did not support an all-out push for the development of the Super, preferring instead to concentrate on tactical nuclear weapons.[94] In early November, despite the GAC report and his own opposition to the Super, Lilienthal had to report to Truman that a thermonuclear bomb could be built within three years.[95]

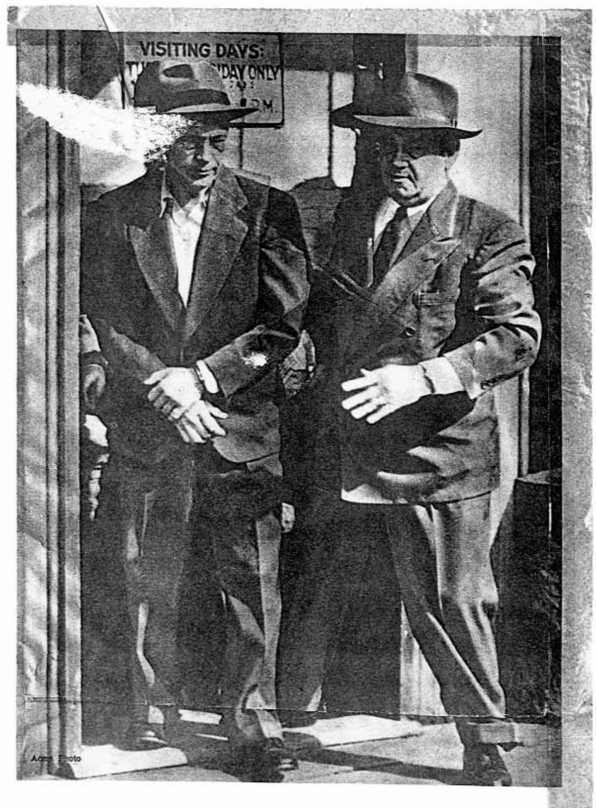
During this period, development of the Super was advocated by most of the nation's leadership, including Dean Acheson, the Secretary of State, and the Joint Chiefs of Staff.[96] The AEC itself had to fall in line. Even though Lilienthal was personally opposed, he reluctantly agreed to go along with the AEC majority report favoring the Super, if he could make a dissenting view directly to President Truman when the AEC presented its formal recommendations on January 31, 1950. Truman ignored Lilienthal's dissent and signed the AEC recommendations.[97] The Commission was directed to proceed with work on all forms of atomic weapons, including the hydrogen bomb; Congress would be asked to appropriate the funds later that year.[98] Implicit in this directive was the construction of a new facility to produce tritium.

Both Lilienthal and Oppenheimer would pay for their opposition to the H-Bomb. Rendered ineffective by his dissent, and increasingly irritated by the growing demands for secrecy within the AEC, Lilienthal resigned from the Commission on February 15, 1950, in the wake of the Klaus Fuchs revelations.[99] Gordon Dean, a supporter of the new direction, was made head of the AEC. Dean and General Manager Carroll Wilson clashed frequently in the months that followed, leading to Wilson's resignation on August 8, 1950. He was replaced by Carleton Shugg.[100] Oppenheimer was too valuable to suffer the consequences immediately, but he was increasingly isolated from the upper reaches of the AEC. Within a few years, at an AEC hearing, he would be stripped of his security clearance, effectively ending his usefulness to the atomic energy program.

Communism's Threat is Everywhere...



Sunday Magazine newspaper article emphasizing the communist threat to national security. This article, written exclusively for *The Atlanta Journal and Constitution* Magazine by the head of the FBI, J. Edgar Hoover, demonstrated the possibility that spies could be present on our homefront. Source: *The Atlanta Journal and Constitution*, circa 1950.



Alfred Dean Slack (left) is shown here as he was being jailed to face trial for spying. He lived in Atlanta in 1947; is now in Federal Pen.

In the meantime, an interagency committee chaired by Paul Nitze coordinated Truman's push for the Super; the committee's report, NSC-68, came out in April 1950. During this period, Congress took up the dispute between the development of the Super and the development of tactical nuclear weapons, a debate that was not resolved until the outbreak of the Korean War. After that, Congress simply decided to develop both. As a result, from 1950 to 1951, the Defense budget swelled from \$13.5 billion to \$48.2 billion.[101] All of this led to the creation or expansion of a number of nuclear facilities

designed to develop the new weapons. The Los Alamos Scientific Laboratory was renovated, and new facilities included the Lawrence Livermore Laboratory, long pushed by Teller as a new hydrogen-bomb research center. Among the proposed facilities was a new plant for the production of tritium.[102] At the beginning 1950, it was not yet known who would run the new tritium facility or where it would be located, but both of those questions would be resolved by the end of the year.